

WHAT IS CLAIMED IS:

1. A negative electrode for a lithium sulfur battery comprising:
a lithium metal;
a pre-treatment layer formed on the lithium metal, the pre-treatment layer having a
5 thickness of 50 to 5000Å and including a lithium ion conductive material with an ionic
conductivity of at least 1×10^{-10} S/cm; and
a protection layer for the lithium metal.
2. The negative electrode of claim 1, wherein the lithium ion conductive material
is Li_xPO_y , where $2 < x < 4$ and $3 < y < 5$.
- 10 3. The negative electrode of claim 2, wherein the lithium ion conductive material
is Li_3PO_4 .
4. The negative electrode of claim 1, wherein the ionic conductivity of the lithium
ion conductive material ranges from 1×10^{-10} S/cm to 1×10^{-6} S/cm.
5. The negative electrode of claim 1, wherein the protection layer for the lithium
15 metal comprises $\text{Li}_a\text{PO}_b\text{N}_c$, where a is 2 to 4, b is 3 to 5, and c is 0.1 to 0.9.
6. The negative electrode of claim 5, wherein the protection layer for the lithium
metal comprises $\text{Li}_{2.9}\text{PO}_{3.3}\text{N}_{0.46}$.
7. The negative electrode of claim 1, wherein the protection layer for the lithium
metal has a thickness of 1000Å to 50μm.
- 20 8. The negative electrode of claim 1, wherein the protection layer is formed on the
pre-treatment layer.
9. A method of preparing a negative electrode for a lithium sulfur battery
comprising:
depositing a pre-treatment layer on a lithium metal under an inert gas atmosphere, the
25 pre-treatment layer including a lithium ion conductive material with an ionic conductivity of at
least 1×10^{-10} S/cm; and
depositing a protection layer for the lithium metal on the pre-treatment layer.

10. The method of claim 9, wherein the lithium ion conductive material is Li_xPO_y , where $2 < x < 4$ and $3 < y < 5$.

11. The method of claim 10, wherein the lithium ion conductive material is Li_3PO_4 .

12. The method of claim 9, wherein the ionic conductivity of the lithium ion conductive material ranges from 1×10^{-10} S/cm to 1×10^{-6} S/cm.

13. The method of claim 9, wherein the inert gas is selected from the group consisting of helium gas, neon gas, and argon gas.

14. The method of claim 9, wherein the protection layer for the lithium metal comprises $\text{Li}_a\text{PO}_b\text{N}_c$, where a is 2 to 4, b is 3 to 5, and c is 0.1 to 0.9.

15. The method of claim 14, wherein the protection layer for the lithium metal comprises $\text{Li}_{2.9}\text{PO}_{3.3}\text{N}_{0.46}$.

16. The method of claim 9, wherein the protection layer for the lithium metal has a thickness of 1000Å to 50μm.

17. A lithium sulfur battery comprising:
a negative electrode comprising a lithium metal, a pre-treatment layer formed on the lithium metal, having a thickness of 50 to 5000Å and including a lithium ion conductive material with an ionic conductivity of at least 1×10^{-10} S/cm, and a protection layer for the lithium metal;
a positive electrode comprising a positive active material selected from the group consisting of elemental sulfur, sulfur-based compounds, and mixtures thereof; and
an electrolyte.

18. The lithium sulfur battery of claim 17, wherein the lithium ion conductive material is Li_xPO_y , where $2 < x < 4$ and $3 < y < 5$.

19. The lithium sulfur battery of claim 18, wherein the lithium ion conductive material is Li_3PO_4 .

20. The lithium sulfur battery of claim 17, wherein the ionic conductivity of the lithium ion conductive material ranges from 1×10^{-10} S/cm to 1×10^{-6} S/cm.

21. The lithium sulfur battery of claim 17, wherein the protection layer for the

lithium metal comprises $\text{Li}_a\text{PO}_b\text{N}_c$, where a is 2 to 4, b is 3 to 5, and c is 0.1 to 0.9.

22. The lithium sulfur battery of claim 21, wherein the protection layer for the lithium metal comprises $\text{Li}_{2.9}\text{PO}_{3.3}\text{N}_{0.46}$.

23. The lithium sulfur battery of claim 17, wherein the protection layer for the
5 lithium metal has a thickness of 1000Å to 50µm.

24. The lithium sulfur battery of claim 17, wherein the protection layer is formed on the pre-treatment layer.